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Research Program Development and Evaluation Staff
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REPORT AND RECOMMENDATIONS
of the
GRAIN AND FORAGE CROPS RESEARCH ADVISORY COMMITTEE
Developed at its Meeting
March 6 - 10, 1967
Washington, D. C.

Committee Membership:

Lloyd E. Arnold, Seed Producer and Distributor, Arnold-Thomas Seed Service, Fresno, California
Dale W. Bohmont, Dean, College of Agriculture and Director, Agricultural Experiment Station, University of Nevada, Reno, Nevada
Richard B. Feitshans, Grass and Forage Producer, Perry, Georgia
J. W. Fielder, Alfalfa Producer and Processor, Dixon, California
John M. Greig, Grain Producer, Estherville, Iowa
K. K. Keneaster, Product Services Director, Uncle Ben's, Inc., Houston, Texas
Clay W. Kennedy, Grain Producer, Brownville, Nebraska
Byron S. Miller, Head, Special Projects Department, General Mills, Inc., Minneapolis, Minnesota
Milton L. Morrison, President, Morrison Grain Company, Inc., Salina, Kansas
A. Lars Nelson, Master, Washington State Grange, Seattle, Washington
B. Regnar Paulsen, Rice Producer, Woodland, California
Paul E. Ramstad, Vice-President, Research and Development, American Maize-Products Company, Roby, Indiana
Hugh J. Roberts, Director, Research and Development Department, Krause Milling Company, Milwaukee, Wisconsin
John Reed Rodgers, Grain and Forage Producer, Belleville, Pennsylvania
Fred J. Watts, Jr., General Manager, Grain Division, Farm Bureau Marketing Association, North Charleston, South Carolina

Additional copies of this report may be requested from W. C. Dachtler, Executive Secretary, Grain and Forage Crops Research Advisory Committee, Research Program Development and Evaluation Staff, U. S. Department of Agriculture, Washington, D. C., 20250.

PREFACE

The annual meeting of the Grain and Forage Crops Research Advisory Committee was held in Washington, D. C., March 6 through 10, 1967, with all fifteen members present. The sessions on the first day were open to the public. During this period the following representatives of agricultural and industry organizations presented their views concerning research needs:

Robert C. Liebenow, President, Corn Refiners Association
Fred H. Mewhinney, Washington Representative, Millers' National Federation
Ted Rice, Chairman, Research Committee, Grain and Feed Dealers National Association
H. C. Schaefer, Director of Research, American Dehydrators Association

On Thursday afternoon the Committee visited the research facilities at the Plant Industry Station and Research Center, Beltsville, Maryland. It reviewed research of Crops, Agricultural Engineering, Entomology and Human Nutrition Research Divisions.

As a basis for its recommendations and comments, the Committee made a systematic review of the Department's research programs for grain, rice, forage, feed and seed, as summarized in a Progress Report supplied to the Committee in advance of the meeting. The Progress Report material was supplemented by oral reports, visual materials, and discussion by program leaders and research administrators from the following USDA research divisions and agency units: Crops; Entomology; Agricultural Engineering; Nutrition and Consumer Use; Northern, Southern, and Western Utilization; Market Quality; Transportation and Facilities; Marketing Economics; Standards and Research; Economic and Statistical Analysis; and Farmer Cooperative Service.

Dr. F. R. Senti, Deputy Administrator, Nutrition Consumer and Industrial Use Research, Agricultural Research Service, acted as Chairman during the meeting. The Executive Secretary was W. C. Dachtler, Head, Research Advisory Committee Secretariat, Research Program Development and Evaluation Staff.

After careful review of the information available, and based upon the current and future need for new knowledge, and the seriousness of problems faced by the industry, the Committee made the comments and recommendations included in this report to the Secretary of Agriculture.

COMMENTS AND RECOMMENDATIONS

GENERAL

Meeting World Food Needs

"For all existence, most men have lived in poverty threatened by hunger. But we dream of a world where all are fed and charged with hope, and will make it so." (President Lyndon B. Johnson's speech April 1965)

"The world is now engaged in a tremendous race against famine, against the awesome prediction that the accelerating global population can outrun the global food production capacity within the next few decades, unless something is done immediately to change the odds in favor of mankind. The American farmer holds the key to whether there will be time enough to avoid disaster.

"There is little prospect that domestic production plus commercial imports will be adequate to fill the food and fiber needs of many developing countries for some years to come, particularly if their present rapid rates of population growth continue, and per capita incomes increase.

"As one of the leaders in world affairs, we are becoming increasingly aware of the critical importance of economic progress in developing countries to the establishment and maintenance of a stable and peaceful world order." (Excerpts from the recent report entitled "A National Program of Research for Agriculture")

The Committee believes that the foregoing statements clearly point up the urgent problems confronting the world in the decades ahead. As the need for food and feed becomes more and more critical throughout the world, intensified research is needed not only to efficiently produce but to protect the multibillion dollar cereal and forage crops from outright destruction, evident deterioration, and hidden damage.

The Committee also agrees with the viewpoint expressed by Robert C. Liebenow, President, Corn Refiners Association, in his statement of research needs before the Committee that "Despite ever changing demand factors, American agriculture still looks for ways to use farm products of all kinds. The need is twofold: (1) Increased utilization of agricultural raw materials betters our standard of living; and (2) increased utilization also helps guarantee the largest possible return to the producers of US food and fiber and, thus, contributes very materially to the narrowing of the farm-urban income gap."

Planning Efficient Use of Research Personnel

Movements and shifts in research personnel often result in detachment from a research study in partial completion. This results in loss of material or costly delays that reduce the research value of reports. Transfers, terminations, leaves of absence, and retirement often cause projects to

lose their value since either the work is not continued to its ultimate completion or publication of results is delayed until the material is no longer timely or usable.

Master planning should include a time schedule for all projects and a supervised reminder catalog of work in progress. Research projects must be followed until data developed have been analyzed and published. We cannot afford the luxury of delays or shifts that cause professional efforts to be lost or reduced in value from lack of timeliness.

Research Project Procedure, Timing, and Termination

Deciding how far to continue, or when to terminate a research project, is always difficult. This may be especially true in the area of industrial utilization when each step along the way reveals new questions of engineering, economics, or customer acceptance. Nevertheless, the Committee feels that more will be accomplished in this area by suggesting opportunities and doing limited work on a variety of ideas and presenting them for industry consideration, rather than by carrying a few projects through such expensive developmental phases as pilot plant work, plant trials, and market research. Decisions to carry projects into these phases, which should normally be done by industry, should only be made after careful top-level review of the pros and cons of devoting limited resources to them.

Research Information Retrieval System

Reasonably complete information on related research, both past and current, wherever done, is essential to planning new research and achieving effective use of knowledge already acquired through research. The Committee commends the Department for recognizing this need and taking the steps necessary to establish a research information retrieval system which will include not only its own program, but those of State Agriculture Experiment Stations and related research of other agencies. Such a system can be an important means of enhancing the efficiency of manpower utilization, thus offsetting in some degree rising research costs.

Effective Use of P.L. 480 Funds

P.L. 480 money has been effectively used to carry out contract research in several countries where funds and competent scientific personnel were available. With extension of the P.L. 480 program, the Committee suggests other related uses of these funds be considered. It recommends that P.L. 480 funds be employed to provide training grants for people in developing nations, to build applied research centers employing US educated natives of these countries, and to help solve food, nutritional, and agricultural problems within the developing nations.

Research Manpower Supply

The report "A National Program of Research for Agriculture" reflects a positive point of view that there will be an adequate number of qualified

trained scientists available as they graduate from our institutions of higher education to fully staff projected needs for research personnel in publicly conducted research programs. This may be an overly optimistic point of view. The need for qualified scientists will continue to be on the increase. The competition for good research minded individuals in the years immediately ahead will be keen and further intensified as industry continues to expand its research activities in more and more fields.

Certainly to avoid disrupting the availability of trained scientists, caution must be exercised to assure that adequate numbers of students are permitted and encouraged to continue their studies and undertake post-graduate work to the end that our research goals, both public and private, may be reached.

Some of the goals projected for manpower needs in this report would appear fraught with danger of coming up short of indicated needs by 1977. Specifically we would like to call attention to projections on "Technical Assistance to Developing Countries" where the indicated need by 1972 is nearly fourfold over 1965 requirements.

Adequate Support Level for Research

The Committee believes more recognition should be given in budget considerations to the need for meeting the average cost increase of carrying on research which amounts to about 6 percent per year. This is necessary to maintain the current level of research. It results not only from rising price levels, but from the need for more complex equipment and facilities to cope with the increasingly more difficult research problems confronting the agricultural research scientist. An adequate support level including the annual cost increment is essential to the efficient use of research manpower and other resources. This should be given greater weight in budget considerations of additions and deletions to the program.

Proposed Legislative Reorganization

The Committee is deeply disturbed by the provisions in Senate Bill No. 355 - Legislative Reorganization - which would transfer consideration of some of the agriculturally oriented appropriations from the House Committee on Agriculture to a newly constituted Committee on Education. Funds for agricultural colleges and State experiment stations and the agricultural extension services under the proposed bill would become the responsibility of the new Committee.

In view of the close relationship and excellent cooperation of the USDA and State agencies for many years and especially now that there is a comprehensive agricultural research plan for a national program jointly prepared and administered, a separation of budget consideration will tend to make less effective the coordination of the Federal-State phases. The Committee strongly urges that all agricultural budgets continue to be reviewed by and the appropriation responsibility remain with the Committee on Agriculture.

FARM RESEARCH

Breeding, Culture, Disease and Evaluation Research

In reviewing the research effort two areas of activity stood out in the minds of the Committee, namely, the breeding program and the utilization program. This is in no way intended to detract from the other areas of investigation which also are of prime importance in the team approach, but merely to emphasize these two areas which contribute materially to the gross national product and net worth.

It appears to the Committee that the breeding program generally provides one of the most promising areas of meeting the goals of higher productivity; insect and disease resistance; quality improvement and meeting the world needs for food, feed and fiber.

The Committee noted with pleasure that in general the staff has initiated or expanded work on many of the recommendations made at previous meetings of the Committee. The Committee urges the continuation of the projects underway and action on previous recommendations, which have not yet been dealt with, as personnel and funds permit.

The Committee notes the need for high priority being placed on a team approach in research to study the stress physiology of cereal grains and forages and its relation to applied problems.

More specifically, the Committee wishes to make recommendations regarding each of the following crops:

Barley. It is noted with alarm that barley, as a major feed grain, is being encroached upon by the competition of other crops which have had more dramatic increases in yield. In order to close the yield gap as a feed grain and for commercial uses, we recommend that the Department undertake immediately an acceleration in the program to develop hybrid barley.

Activity should also be carried on in other methods of increasing yield such as through plant introduction and varietal development. An example of dramatic results from this sort of activity can be pointed to the importation of Mexican varieties of wheat in the Southwestern part of the United States which resulted in substantial yield increases in wheat.

Corn and Sorghum. A genetic basis has been established for resistance to certain diseases and insect pests and for the control of end products of synthesis for carbohydrates, fats and proteins. In view of such developments, there is a definite need to expand existing work and to establish new work in biochemistry and biochemical genetics.

We encourage further exploration of the photosynthetic efficiencies both between and within inbred lines. If reliable information can be obtained on these apparent differences, it could lead to increasing production efficiency.

In programing development of new varieties of corn and sorghums, design of the program should be geared to the end use of the extended product. In the past these crops have been considered primarily as feed grains and most development has been aimed at satisfying feed uses. As these grains are processed for a variety of uses, it is important to program new developments with this in mind.

Wheat. It is noted that the projected demand for wheat, worldwide, exceeds present production. Therefore, it is of the most urgent importance to solve the economic production problems attendant to making hybrid wheat commercially available. In this connection it is also suggested that overseas research be encouraged to promote the increased production of wheat.

Wheats with higher lysine content should continue to be sought and increased emphasis should be placed on solving this problem.

Oats. Continued research on disease and insect resistance is essential and the existing work on varietal improvement is justified.

Rice. The Committee recommends continuing the existing work on rice with particular emphasis on the breeding program for Helminthosporium oryzae resistance; a lighter hull color in early maturing long-grain disease resistant varieties; higher protein, higher lysine and threonine varieties and a short stronger straw for all varieties. An amino acid analyzer at the Rice Quality Laboratory in Beaumont, Texas, is needed to expedite work on screening the world collection of varieties for lysine and threonine. It is also suggested that other control methods be sought for Helminthosporium oryzae and kernel smut.

Alfalfa. The Committee recommends that existing work be continued on alfalfa and stresses the emphasis needed in two areas. First, a higher priority should be placed on insect control (especially alfalfa weevil) and second, research should be intensified to increase forage yield with specific attention given to mechanization of the crop. Higher yields and mechanization are essential for alfalfa to continue its important role in livestock farming.

The breeding programs to date have primarily emphasized the development of varieties with yield, disease and insect resistance as their principal objectives. The Committee urges

the programing of research in alfalfa to give more weight to the factors important in nutrition, i.e., increased levels of proteins, fat soluble vitamins and pigmentation.

The Committee commends the Department upon the release of eleven germ plasm pools in alfalfa and the initiation of a crash program on alfalfa weevil control.

Clover. We strongly urge further exploration in the area of interspecific hybridization of trifolium species as a possible avenue to variety improvement in clovers.

Seed Crop Culture. Pollinator preference appears to be a heritable characteristic within honeybee population. Therefore, we urge that particular basic research emphasis be directed towards determination of (1) the factors which constitute attractiveness to the honeybee, and (2) the effect of genotype, agronomic practice and climate on the morphological and biochemical changes associated with attractiveness to honeybees.

There is a serious lack of basic information on the physiology and biochemistry of a seed during the period of maturation, dormancy, and longevity and on the factors determining seed vigor. Without adequate seed of known performance of so many of our grain and forage crops our supply of food, feed and fiber might drop to a point where domestic requirements would be inadequately met. Thus, more emphasis should be directed to basic research to unlock so many of the still unknown aspects of the function of a seed. Furthermore, such information would be of paramount importance in knowing how to protect seed from thermonuclear fallout.

Forage. We wish to put special emphasis on the need for developing a quick test for forage quality.

Turf. In view of the increasing acreages of turf grasses, there is an urgent need for more specific information pertaining to the establishment and maintenance of healthy turf.

Pasture and Range. Additional information is needed in relation to effective range seeding. This work should receive more emphasis.

It is necessary to evaluate all components of livestock feed utilization as a complete system, and not as a series of independent elements. The role of each component, grain, forage, and mineral supplements, their interactions and complementary effects on livestock enterprises needs to be defined.

Control of Weeds

Harmful weeds continue to be a major cost in American agricultural production on range, pasture, and croplands. Even though commendable progress has been made during recent years on methods of control, there is need to intensify investigations on almost every phase of weed control problems. Special emphasis should be given to the following areas: (1) More effective herbicides with low residual toxicities for the control of such hard-to-kill weeds as Johnson grass, creeping broadleaved perennial weeds, aquatic weeds in rice and deep-seeded annual weeds; (2) the biochemistry and basic physiology of seed dormancy and weed development and growth; and (3) basic and detailed ecology must be developed to understand the principles of brush control through the use of fire, chemical, biological and mechanical methods for use on the Nation's arid rangelands.

Control of Nematodes

Studies on nematodes have long been denied their rightful place. Only through understanding the complexities of the soil environment is it possible to understand the symptoms of the above-ground plant growth. The damage of nematodes to almost every crop can only be arrived at today by guess-work. It is necessary that basic understanding be established to determine the seriousness of the nematode menace. The following areas should be initiated or intensified: (1) The review and identification of the types of nematodes infesting pasture, range and croplands and (2) basic studies to understand the distribution and the importance of host-parasite relationships.

Control of Insects

Insects are always a threat to the Nation's agricultural production. It is, therefore, necessary that research to control these pests be continued and intensified. The insect research group is commended for the imagination and leadership given to the solution of the Nation's insect problems. Yet, there is a growing concern that not enough progress is being made in certain areas of insect control. Specific suggestions for emphasis are as follows: (1) Search for more effective and safe insecticides; (2) reaffirm the urgent need of finite tolerance levels for residues of insecticides; (3) intensify programs designed to meet the increasingly serious insect problems of such pests as alfalfa aphid, alfalfa weevil, corn borer, corn earworm and corn root worm, applying the principles of integrated control; and (4) intensified effort must be made by entomologists working as team members with other scientists to establish principles of the biochemical nature of resistance of plants to insects. Resistant plants, if available, are by far the most economical and practical way of avoiding insect losses.

Agricultural Engineering

The efforts of the agricultural engineering research program to address itself to the problems of the industry and to seek solutions are commendable. These scientists are encouraged to continue to adjust their research effort from low priority to high priority research. The following are specific suggestions which need to be considered by the engineering research scientists: (1) Care must be taken to avoid becoming a service agency for the design of equipment with little or no industrial potential; (2) research on the development of principles involved in the handling and processing of forage must be intensified with full recognition given to the economies attained through mechanical handling of feeds as automation progresses; (3) the development of engineering design criteria for storage structures and the related handling systems should be intensified as soon as possible; and (4) the systems approach to research needs to be applied to the engineering research effort -- for example, the mechanization of harvesting, processing, storage and related utilization of forage -- must be given a high priority for future research efforts.

NUTRITION, CONSUMER AND INDUSTRIAL RESEARCH

Human Nutrition and Consumer Use

The Committee looks forward to publication of the results of the 1965-66 nationwide food consumption survey, and recommends that the survey be repeated in 1970-71 and every five years thereafter. Consideration should be given to a simultaneous nationwide survey of the nutritional status of the population to permit better identification of the nature and extent of problem areas in human nutrition in the United States.

Information on the nutritive content of cereal foods such as that published in Agricultural Handbook No. 8 is of great value and should be kept current by the addition of similar data on commercial cereal products. However, there also is urgent need for basic information defining the availability to man of carbohydrates, amino acids, minerals and other nutrients in cereal foods.

Major differences exist between the nutritional requirements of man and laboratory animals; hence, new biochemical and physiological methods must be developed for the study of metabolic response and nutritional status of human subjects. Present work aimed at determining metabolic differences among dietary carbohydrates should be continued with human subjects. The Committee is pleased to note that the "National Program of Research for Agriculture" proposes a sharp increase in effort in the problem area of human nutritional well-being (Goal VII-8); a significant part of that increase should be directed toward the measurement of human nutritional responses.

There is need for research on methods for relating the physical and chemical properties of food to consumer acceptability. Since this is fundamental research, and since it has direct bearing on the development of new cereal food products that appeal to the preference of consumers in other countries (National Program for Research in Agriculture, Goal VI-1), consideration should be given to conducting the research in a food-aid recipient country, possibly with P.L. 480 funds.

Efforts should be expanded to take full advantage of other Federal programs related to human nutrition, as has been done with the School Lunch Program. Information pertinent to human nutrition research that is generated by various divisions within the Department of Health, Education and Welfare should be utilized to the maximum extent in the USDA human nutrition research program.

Food Utilization

Emphasis should be placed on basic studies of chemical composition, physical, biochemical and nutritional properties and structure of cereal grains and their commercial fractions and of certain traditional feed and forage crops, such as sorghum and alfalfa, which have a potential place in human nutrition. Cooperation should be maintained between the utilization research personnel and plant breeders so that samples used in basic studies have a known history.

Work should be expanded on rheological studies of cereal grains, their fractions and derivatives. A special laboratory should be equipped and staffed to specialize in this area on a continuing basis.

There is need for continuing research in improvement of analytical methods especially with regard to nutrients so that their role in human and animal nutritional response will be more meaningful.

Wet processing of alfalfa should be investigated for separating high protein fractions suitable for human food.

The studies on wheat byproducts should be extended to include corn, sorghum, rice, barley and other cereal byproduct fractionation to yield products suitable for human food.

Investigate the effect of Simazine and other hormones on increase in protein content of cereal grains and forages.

Expand research on rice (1) to improve milling of rice to minimize breakage, (2) to determine factors affecting flavor and aroma of rice and (3) to develop conclusive information as to effects of deep-milling for production of high protein flour on the properties and utility of the residual kernels.

Industrial Utilization

With the elimination of large commodity surpluses, expanding food needs and shortage of scientific personnel, the Committee feels that consideration should be given to a shift in emphasis from industrial developmental projects to those which are more basic and those which are related to food and feed needs. Pilot plant testing should be restricted to areas where industry is not capable of such work.

Work on acid modified flour should be terminated.

Improvements and/or automation of the method for determining amylose should be attempted so fewer technicians can handle a greater number of samples.

Work should be initiated to develop a more reasonably priced broad line nuclear magnetic resonance instrument for measuring moisture and fat content of food and feed materials.

Research on the use of naturally isolated micro-organisms, as well as those developed through the use of genetic principles for a specific capability, should be expanded.

Work on mycotoxins should be expanded to include finding rapid means for measuring, and practical methods for removing or inactivating these compounds.

Feed Utilization

Feeding values of grains, forage crops, and mill-feeds cannot be fully described by the usual proximate analyses, nor even by a more detailed quantitative description of their constituents. Instead, feeding value is dependent upon processing which affects nutrient availability, as well as upon composition. Achieving maximum value from a feedstuff may sometimes require its separation into fractions suited to the needs of ruminants and monogastric animals, and further processing of these to assure maximum energy utilization.

Work at the Western Utilization Research Laboratory and elsewhere has demonstrated techniques that are useful in enhancing the feed value of dehydrated alfalfa and mill-feeds from wheat. The potential value of these observations makes it imperative that they be further verified and extended to other forage crops, to corn, sorghum and other grains, and to testing of other related processing methods that may have merit.

Attention should be directed to the analytical methods and factors commonly used to describe feed ingredients. For example, work is needed in determination of cellulosic compounds and lignin, amino acid availability and particularly metabolizable energy values. This would facilitate sound formulation of livestock rations and lead to more effective utilization of feedstuffs.

Research with the objective of isolating and identifying unidentified growth factors in alfalfa should be supported. High protein flour fractions might be employed in special types of animal feeds, e.g., milk replacers for calves.

Consideration should be given to the possibility of developing human foods from materials heretofore regarded only as feedstuffs. Similarly, those processing techniques which are known to increase the availability of nutrients in feeds should be considered for their value in extending food supplies in those areas of the world where food shortages are prevalent.

MARKETING AND ECONOMIC RESEARCH

The Committee recognizes the importance of research in this area and is pleased that funds for this purpose have not been curtailed but show a slight increase. We recognize not only the need for funds to finish projects nearing completion, to carry on those that are continuing projects, but also see the need for a constant movement to keep these investigations on target. Due to rising costs with constantly increasing population which is expected to reach 235 million in our country by the year 1980 and a world population of 4 billion by 1972, there must be additional funds designated for research to meet needs as they arise. Deferment in this connection may be courting disaster.

The progress with funds available and committed to bringing the new USDA marketing facility on the line at Kansas State University in close proximity to the world famous milling and baking laboratories is commended.

Projects in progress are moving satisfactorily. New proposals are worthy and sound. Whether in basic or applied research, the new and proposed projects described to us by USDA scientists appear sound, practical and in accord with need and progress. We are making the following recommendations for agricultural industry progress in the public interest.

Measurement of Market Quality

The Committee wishes to commend the Department for progress made in development of mechanical samplers which has resulted in the approval for use of three types of these devices. Because mechanical sampling of grain is relatively new, and because of the economic importance of obtaining accurate samples, we recommend that additional study be made of the accuracy of samples obtained with primary samplers and secondary samplers or dividers of variable design and installed at variable locations in the grain stream. We recommend that standards and tolerances be established for the design and installation of mechanical samplers to insure that results are uniformly accurate.

The Committee is pleased that funds have been appropriated for the study of automated grading of grain. Objective determination of grade factors which are now made by subjective judgments of inspectors would result in more uniform inter-market grades. More reliable determination of quality factors of grain will facilitate trading.

Reports continue to circulate in farm and trade circles that export grain arrives at destination showing lower quality than at time of loading. Most frequent reports concern corn arriving in poor condition due to "heating." There should be studies to ascertain the frequency of actual out-of-condition arrivals and research to determine necessary preventative measures.

Emphasis should be given research on the structure of proteins and the factors underlying gluten quality of wheat.

Methods of determining the digestability and other factors not now known which affect the feed value of feed grains and forages should be studied. Perfection of such tests would facilitate evaluation and marketing of these products.

Work should be continued to perfect methods of determining variety, germination and vigor of seed by chemical test or other quick methods.

New Foods, Protection, and Market Expansion

Research should be continued on health benefits of cereal and dehydrated forage crops in human diets with emphasis on the effects on blood characteristics.

A quick test for determining the presence of aflatoxin and salmonella in grain feed and forage should be developed. Study should be made of methods of treating agricultural products infected with aflatoxin or salmonella so they may be used for food or feed.

Priority should be given research on development of supplemental protein foods to meet nutritional needs of people in other countries and development of new and improved food products that appeal to the preferences of consumers in other countries.

There is evidence that cows fed dry rations in confinement produce milk with an oxidized flavor. We recommend research to determine if the flavor of such milk can be improved by feeding milk cows with vitamin E or dehydrated alfalfa.

Maintenance of Market Quality

Control of insects and micro-organisms in stored cereals and forages is of growing concern to producer, processor, industrial user and consumer as a greater awareness is developing of the potential impact of insecticides,

fungicides, fungi and bacteria upon the quality of the end product.

Studies must be continued to develop new means of insect control as well as fungi and bacterial detection, destruction, removal or neutralization. We must also learn how these potential contaminants are introduced and how they affect our stored commodities.

While new chemical means of achieving these results must be explored, it is recommended that new techniques involving biological control, diatomacious earth, sonic waves, temperature controls, radio frequencies, irradiation and controlled atmospheres be given high priority.

USDA personnel are to be commended for their efforts in assisting the Food and Drug Administration to determine tolerance levels small but finite rather than "zero tolerances." We urge continuance of this cooperative work to include additional chemicals and techniques for their use.

We are pleased to note the action in the use of P.L. 480 funds for stored grain insect research abroad and we hope this program may be enhanced and expanded.

Marketing Facilities, Equipment and Methods

The most efficient use of aeration and drying systems using both heated and unheated air assumes increasing importance, particularly in view of the expanding field shelling of high moisture corn. While high moisture corn is emphasized, the conditioning and care of all stored grain and forage crops is important in the light of potential losses due to the presence of mycotoxin.

Vacuum drying, controlled atmosphere, and refrigerated storage are largely unexplored fields and merit research.

Air pollution in its many forms is a national menace. The grain and grain-product and forage industries share this problem with other segments of the economy. Research is needed to establish criteria and develop practical methods of dust control.

Cooperative Marketing

It has been succinctly stated in the report "A National Program of Research for Agriculture" that "Marketing must be looked upon as a dynamic and changing process. The capacity to adjust to and cope with the dynamics of modern marketing is required increasingly of producers and distributors of farm products. Through research on the different facets of market development, information is provided farm groups, processors, distributors, which enables them to make the most of new market outlets. Research on farmer bargaining power is needed to find more ways to improve the terms of trade between farming and other sectors of the economy."

It should be noted that research done for cooperatives is available to anyone interested. The current level of research and projects in action appear to cover needed areas on problems affecting cooperatives. There are additional areas for investigation contemplated as current projects are completed, to be initiated in 1967 and 1968 that are essential and desirable.

We would approve an early investigation of: (1) Cost-benefits of on-farm elevator storage as a result of changes in harvesting equipment and methods of harvesting, (2) implications of changes in the structure of agriculture and the feed industry to cooperatives handling feed, and (3) benefits to rice cooperatives which might be realized by extending their processing and marketing activities.

Economics of Marketing

Movement of commodities from producer to the ultimate domestic consumer can result in cost of transportation equivalent to 40% or more of the farm price. It, therefore, seems essential to effect economies in the handling and transportation of our forage crops and cereals.

Handling and tumbling must be minimized. Air, water, rail and motor transport should be coordinated so that a single commodity could be moved by all transport methods with a minimum of labor. Unitized transport modules need to be developed that can be used interchangeably by all transport forms.

New concepts in transport are necessary to introduce efficient techniques that will not be bound by traditional handling methods.

Rate structures for public transport must be analyzed continually to determine whether they reflect the economies which may be possible by use of the new techniques.

Growing world demand and particularly potential demand from developing countries for additional foods justifies high priority for studies to make the greatest possible use of cereal grains, and protein supplements derived from forages in human nutrition.

As world population grows, the United States will be faced with increasingly complex problems in the area of providing for the food needs of developing countries. Research is needed to determine how such needs may best be met based on supply, production capacity and cost; also in the area of determining the potential production capacity of these countries and their projected ability to process native or imported raw food stuffs.

There should be continuing research regarding all aspects of international trade in grain and forage products to assist the United States and its private enterprise system in competing vigorously and successfully with foreign governments and trading combines.

Consumer Quality Discrimination

In our complex marketing economy it has become increasingly difficult for consumers to reflect their preferences, opinions and dissatisfactions with products to producers and marketers. Studies made by the Special Survey Branch afford various kinds of consumers an opportunity by a sampling process to express what the individual thinks about agricultural products.

With new food products appearing in increasing numbers, research should be expanded in the area of consumer discrimination and preferences for food products differing in quality and flavor factors. This research should include studies of products made from alfalfa, edible beans, soybeans, grain sorghum, corn, wheat, rice and other cereals in their various forms. These small-scale studies conducted under controlled conditions give direction to later household placement tests, aid industry in planning efforts for more effective marketing, provide an evaluation of possible consumer acceptance of new developments or variations, and provide insights into the effectiveness of scientific research designed to develop agricultural products with greater appeal and usefulness to consumers.

It is requested that a study be initiated to relate consumer taste preference in milk to the utilization of different feed rations containing various alfalfa types in the production of milk.

Statistical Data

The Committee feels that there needs to be continued effort directed toward the refinement of data, increased accuracy on adequate sampling of statistical data, on field data preparation, as well as research compilation and interpretation. Justification for more and better data furnished by farmers should be stressed both in selection of reporters and recognition given for accuracy and continuity in this essential effort of voluntary reporting. As the ratio of population explosion worsens in relation to food production capability in the nation and throughout the world, our crop production and inventory stocks and those in other countries become more and more important to meet emergency, famine and nutritional needs of all people.

All of this is accentuated by the uncertainties prevailing in world relations, when population thrust shows a ratio of 2 to 1 in terms of people and food and our acceptance of the humanitarian responsibility of feeding and clothing a large share of the world's people. Increasing importance must, therefore, be attached to determination of our reserve requirements -- how much must be visible on hand, in storage, or readily available from the soil or in the next crop. Even as we meet the needs of ourselves and others, we must ascertain through planning and evaluation based on sound statistics our production needs so as not to have the very abundance produced become a surplus demoralizing influence on the price system and the economic structure of agriculture.